

What is claimed is:

1. A method for etching a silicon substrate, comprising:
forming an etching mask on a silicon substrate surface; and
performing an etching step for forming a predetermined structured surface by dry etching said silicon substrate surface,
wherein said etching step comprises repeating in sequence:
 advancing said dry etching primarily at an etching ground using an etching gas and a protective film forming gas;
 forming a protective film using said protective film forming gas on a structured surface formed by said dry etching; and
 removing said protective film formed on said etching ground.
2. A method for etching a silicon substrate according to claim 1 wherein a small amount of said protective film forming gas is supplied during advancing the dry etching and a large amount of said protective film forming gas is supplied in forming said protective film.
3. A method for etching a silicon substrate according to claim 1, wherein a bias voltage is provided by applying electrical power to said silicon substrate during advancing the dry etching and removing said protective film or during removing said protective film.
4. A method for etching a silicon substrate according to claim 1, wherein a reactive gas is used for said etching gas.

5. A method for etching a silicon substrate, comprising repeating in sequence:
forming an etching mask on a silicon substrate surface; and
performing an etching step for forming a predetermined structured surface by dry etching said silicon substrate surface through an opening in said etching mask using an etching gas converted to plasma via high-frequency electrical power,
wherein said etching step ,comprises repeating in sequence:
advancing primarily dry etching of an etching ground using an etching gas and a protective film forming gas; and
forming a protective film primarily on a structured surface perpendicular to said etching ground using an etching gas and a protective film forming gas.
6. A method for etching a silicon substrate according to claim 5, wherein a small amount of said protective film forming gas is supplied during advancing the dry etching and a large amount of said protective film forming gas is supplied in forming the protective film.
7. A method for etching a silicon substrate according to claim 5, wherein a bias potential is provided by continuously applying electrical power to said silicon substrate during said etching step.
8. A method for etching a silicon substrate according to claim 7, wherein electrical power applied to said silicon substrate is set high during advancing the dry etching and is set low during forming the protective film.

9. A method for etching a silicon substrate according to claim 5, wherein a reactive gas is used for said etching gas.

10. A method for etching a silicon substrate, comprising repeating in sequence:
forming an etching mask on a silicon substrate surface; and
performing an etching step for forming a predetermined structured surface by dry etching said silicon substrate surface through an opening in said etching mask using an etching gas converted to plasma via high-frequency electrical power,
wherein said etching step comprises repeatedly performing in sequence:
providing a bias voltage by continuously applying electrical power to said silicon substrate during said etching step,
advancing primarily dry etching of an etching ground using an etching gas and a protective film forming gas; and
forming a protective film primarily on a structured surface perpendicular to said etching ground using an etching gas and a protective film forming gas.

11. A method for etching a silicon substrate according to claim 10, wherein a small amount of said protective film forming gas is supplied during advancing the dry etching and a large amount of said protective film forming gas is supplied in forming the protective film.

12. A method for etching a silicon substrate according to claim 10, wherein

electrical power applied to said silicon substrate is set high during advancing the dry etching and is set low during forming the protective film.

13. A method for etching a silicon substrate according to claim 10, wherein a reactive gas is used for said etching gas.

14. A method for etching a silicon substrate according to claim 13, wherein

an etching gas and a protective film forming gas converted to plasma are used; and

said high-frequency electrical power used when generating plasma is set high.

during advancing the dry etching and set low during forming the protective film.

15. A device for etching a silicon substrate comprising:

an etching chamber for housing a silicon substrate serving as an item to be etched;

a base disposed below said etching chamber and on which said silicon substrate is
mounted;

means for supplying an etching gas to said etching chamber;

means for supplying a protective film forming gas to said etching chamber;

means for reducing pressure in said etching chamber;

means for generating plasma, including a coil disposed at an outer perimeter of
said etching chamber and opposing said etching chamber, wherein high-frequency electrical
power is applied to said coil, and the etching gas and the protective film forming gas
supplied to said etching chamber are converted to plasma;

means for applying high-frequency electrical base power to said base;

means for controlling gas flow of said etching gas and said protective film forming gas supplied to said etching chamber by said etching gas supplying means and said protective film forming gas supplying means;

means for controlling electrical coil power applied to said coil in said plasma generating means; and

means for controlling electrical power applied to said base by said high-frequency electrical base power applying means;

wherein said gas flow controlling means is formed so that said protective film forming gas is continuously supplied to said etching chamber and said etching gas is intermittently supplied to said etching gas.

16. A device for etching a silicon substrate according to claim 15, wherein said gas flow controlling means supplies a large amount of said protective film forming gas to said etching chamber when said etching gas is not being supplied and a small amount of said protective film forming gas to said etching chamber when said etching gas is being supplied.

17. A device for etching a silicon substrate according to claim 15, wherein said electrical base power controlling means periodically changes said electrical power applied to said base, applying low electrical power to said base when said etching gas is not being supplied and applying high electrical power when said etching gas is being supplied.

18. A device for etching a silicon substrate according to claim 15, wherein said

electrical coil power controlling means periodically changes power applied to said coil, applying low electrical power when said etching gas is not being supplied and applying high electrical power when said etching gas is being supplied.

19. A device for etching a silicon substrate comprising:

an etching chamber for housing a silicon substrate serving as an item to be etched;

a base disposed below said etching chamber and on which said silicon substrate is mounted

means for supplying an etching gas to said etching chamber;

means for supplying a protective film forming gas to said etching chamber;

means for reducing pressure in said etching chamber;

means for generating plasma, including a coil disposed at an outer perimeter of said etching chamber and opposing said etching chamber, wherein high-frequency electrical power is applied to said coil, and the etching gas and the protective film forming gas supplied to said etching chamber are converted to plasma;

means for applying high-frequency electrical base power to said base;

means for controlling gas flow of said etching gas and said protective film forming gas supplied to said etching chamber by said etching gas supplying means and said protective film forming gas supplying means;

means for controlling electrical coil power applied to said coil in said plasma generating means; and

means for controlling electrical power applied to said base by said high-frequency electrical base power applying means;

wherein said gas flow controlling means is formed so that said etching gas and said protective film forming gas are continuously supplied to said etching chamber while flows thereof are periodically changed, with said flows being controlled so that phases thereof are opposite of each other.

20. A device for etching a silicon substrate according to claim 19, wherein said electrical base power controlling means periodically changes electrical power applied to said base, applying low electrical power when a small amount of said etching gas is being supplied and applying high electrical power to said base when a large amount of said etching gas is being supplied.

21. An device for etching a silicon substrate according to claim 19, wherein said electrical coil power controlling means periodically changes electrical power applied to said coil, applying low electrical power when a small amount of said etching gas is being supplied and applying a high electrical power when a large amount of said etching gas is being supplied.

22. A device for etching a silicon substrate comprising:
an etching chamber for housing a silicon substrate serving as an item to be etched;
a base disposed below said etching chamber and on which said silicon substrate is mounted;
means for supplying an etching gas to said etching chamber;
means for supplying a protective film forming gas in said etching chamber;

means for reducing pressure in said etching chamber;

means for generating plasma, including a coil disposed at an outer perimeter of said etching chamber and opposing said etching chamber, wherein high-frequency electrical power is applied to said coil, and the etching gas and the protective film forming gas supplied to said etching chamber are converted to plasma;

means for applying high-frequency electrical base power to said base;

means for controlling gas flow of said etching gas and said protective film forming gas supplied to said etching chamber by said etching gas supplying means and said protective film forming gas supplying means;

means for controlling electrical coil power applied to said coil in said plasma generating means; and

means for controlling electrical base power applied to said base by said high-frequency electrical base power applying means;

wherein said electrical base power controlling means is formed so that said electrical power applied to said base is periodically changed.

23. A device for etching a silicon substrate according to claim 22, wherein said means for controlling electrical coil power periodically changes said electrical power applied to said coil.

24. A device for etching a silicon substrate comprising:

an etching chamber for housing a silicon substrate serving as an item to be etched;

a base disposed below said etching chamber and on which said silicon substrate is

mounted;

means for supplying an etching gas in said etching chamber;

means for supplying a protective film forming gas in said etching chamber;

means for reducing pressure in said etching chamber;

means for generating plasma, including a coil disposed at an outer perimeter of said etching chamber and opposing said etching chamber, wherein high-frequency electrical power is applied to said coil, and the etching gas and the protective film forming gas supplied to said etching chamber are converted to plasma;

means for applying high-frequency electrical base power to said base;

means for controlling gas flow of said etching gas and said protective film forming gas supplied to said etching chamber by said etching gas supplying means and said protective film forming gas supplying means;

means for controlling electrical coil power applied to said coil in said plasma generating means; and

means for controlling electrical base power applied to said base by said high-frequency electrical base power applying means;

wherein said electrical coil power controlling means is formed so that electrical power applied to said coil is periodically changed.